

Jana Zvárová

European Center for Medical
Informatics, Statistics and Epidemiology
Charles University and Academy of
Sciences,
Prague, The Czech Republic

Education and Training

Medical Informatics, Statistics and Epidemiology Education: In the Framework of the Tempus- Phare Joint European Project

Abstract: Medicine and health care should react to the changing composition of the population, to diseases and new treatments, to the needs of medical ethics and law, and to changing economic conditions and to social needs. The main goal of health care is to improve the health status of the population. To reach this goal the appropriate use of available information, including for example biomedical knowledge, epidemiological data or patient data, is necessary. The need for education in this field of medical informatics, statistics, and epidemiology is a requirement to solve health-care problems, to develop a long-term perspective and successful functioning of health-care systems. The information sciences can play an important role in promoting the construction of basic data, vocabularies and decision procedures, as well as developing formal methods for problem solving.

Because of the complexity of computer applications in medicine and health care a model for ordering the wide variety of computer applications was proposed by Van Bommel [1]. As stressed by Grémy [2] medical informatics, intelligently used, can provide a great aid to medical decision support while leaving room for the intuitive, holistic and affective part of our intelligence. As a basic medical science [3] it can provide key methods of thinking and problem solving which fundamentally affect all medicine and health-care. Nowadays medical informatics is understood to be an interdisciplinary applied science (see, e.g., the IMIA Yearbooks of Medical Informatics [4-6]). However, theoretical soundness is not sufficient as a

measure for success in an applied science but has to be supported by practical achievements. According to the concept of medical informatics as defined above, it is clear that, together with medical statistics and epidemiology, these applied disciplines offer a methodological platform for solving problems in medicine and health care. They offer methods for analyzing information flows; for designing medical databases and knowledge bases; for planning, conducting and analyzing clinical trials, epidemiological studies and surveys; for introducing decision-support methods; for systems analysis, design and implementation; for the evaluation of systems; and for research and education. This common methodology was recognized early by

the Dutch Royal Academy of Arts and Sciences [7] and the Erasmus University Rotterdam [8]. Also in the Federal Republic of Germany a well established position of medical biometry (statistics) and medical informatics has been settled, due to the federal regulation of medical education [9].

In medicine and health care decision making is the basic activity of physicians and other health professionals, when they need to make diagnostic, therapeutic, prognostic, managerial or other decisions. In order to provide adequate information for decision support in medicine and health care and in order to infer from basic data intelligent or expert conclusions that could somehow help in the process of decision making, medical data

should be evaluated by sound methodologies and procedures. However, as is the case in any other inductive reasoning, decision making procedures are frequently influenced by uncertainty, often related to the complexity of the problem. Research in decision support in medicine and health care has been very promising (e.g., [10]) and is bringing new approaches for solving practical medical tasks [11].

Education in the methodology of health care

In January 1993, the Joint European Project (JEP-4358) entitled *Education in the Methodology Field of Health Care - EuroMISE* (European Education in Medical Informatics, Statistics and Epidemiology) started the TEMPUS program, funded from the overall PHARE budget of the Euro-

pean Union (EU) and giving assistance to central and eastern European countries. More detailed information about the aims of the project is given in [16]. Training and education in EuroMISE consists of three overlapping areas: medical informatics, medical statistics, and epidemiology. The teaching scheme has been developed in cooperation with 11 EU universities and some Czech organizations, namely Charles University in Prague (four Medical faculties and the Faculty of Mathematics and Physics), the General Faculty Hospital in Prague and the Academy of Sciences of the Czech Republic (Institute of Computer Science). The list of all IEP-EUROMISE organizations is given in Table 1.

Medical statistics and epidemiology had their place in higher education earlier than medical informatics. The integration of medical informatics into professional school curricula assumes

that the term is clearly defined. For example, in the USA, working from the proposal by the Symposium on Computer Applications in Medical Care (SCAMC) the Task Force offers the definition for medical informatics based on [1] as: 'informatics comprises the theoretical and practical aspects of information processing and communication based on knowledge and experience derived from processes in medicine and health care or other professions' [12]. Beside identifying information processing and communication as key issues, this definition describes the professions firstly as characterized by scientific and empirical aspects (knowledge and experience) and secondly as being of a dynamic nature (processes). The development of medical informatics education is clearly visible from the published results of working conferences organized by IMIA (e.g., [13-15]).

In comparison with other universities in the Czech Republic, Charles University gives the largest number of courses, and together with the Academy of Sciences of the Czech Republic it has the most extensive research in different medical specializations. Nowadays, science and higher education have a closer relationship and increasing interdisciplinary cooperation. This cooperation enables the different disciplines to be enriched with a wide variety of knowledge that might contribute new insights to existing problems. With the support of several projects we have started to realize the transfer of methods from medical informatics, statistics and epidemiology for higher education and research in the Czech Republic.

The key issues of the project are to promote a multidisciplinary approach towards problems in health care, and to focus on healthcare issues which have received insufficient attention in traditional training. The EuroMISE guidelines place considerable emphasis on the need for a wide range of

Table 1: Organizations involved in the EuroMISE Project

Organization	Country Code	Contribution
Charles University in Prague	CZ	C
* First Medical Faculty		
* Third Medical Faculty		
* Faculty Mathematics and Physics		
* Medical Faculty in Hradec Kralove		
* Medical Faculty in Pilsen		
Faculty Hospital in Prague	CZ	
Academy of Sciences of the Czech Republic		
* Institute of Computer Sciences	CZ	
Catholique University Leuven	B	MI
Free University Brussels	B	CE
University Heidelberg	D	CMS, MI, E
GSF - MEDIS Institute Neuherberg	D	C, MI
University Marburg	D	MI, MS
University Bordeaux II	F	MS
Aristotle University Thessaloniki	GR	E
Dublin University	IRL	MS
Erasmus University Rotterdam	NL	CMI, E
University of Limburg	NL	MI
University of Manchester	UK	MI

CZ: The Czech Republic; B: Belgium; D: Germany; F: France; GR: Greece; IRL: Ireland; NL: The Netherlands; UK: United Kingdom; MI: Medical Informatics; MS: Medical Statistics; E: Epidemiology; C: Coordinating/Contracting Center; CMI, CMS, CE: Core Group Centre for MI, MS or E

knowledge, including a thorough understanding of health concepts. Moreover, education and training in this field might help bridge the gap between technological innovation and healthcare practice. The rapid development of medical informatics, statistics and epidemiology curricula highlights the importance of these methodological disciplines for education, research and quality assurance in health care.

The main aim of EuroMISE is to create a teaching network for higher education, first in the Czech Republic and later on in other central and eastern European countries, in close collaboration with universities in EU countries. For this reason the European Center for Medical Informatics, Statistics and Epidemiology of Charles University and the Academy of Sciences (EuroMISE Center) were established as one of the goals of the TEMPUS project and they were ceremonially opened at the occasion of the EuroMISE International Working Conference on Education and Research in Medical Informatics, 30 May - 5 June 1994. The educational part of the conference was devoted to topics of how to teach and present papers at scientific meetings. The conference clearly showed that in the future research and higher education will be strongly intertwined. This will create new challenges and opportunities for university teachers in the 21st century. The Working Conference also disseminated the first knowledge and experience gathered during EuroMISE courses for participants from Hungary, Poland and Romania. The presentation of teaching experience and interdisciplinary research papers on medical informatics and on statistics and epidemiology topics, by EU cooperating universities and central European countries (Czech Republic, Hungary, Poland, Romania), opened up new possibilities for further European cooperation [17]. This is one of the main

goals of the EuroMISE Center of Charles University and the Academy of Sciences and its fulfillment depends not only on efficient support of cooperating faculties of Charles University and research institutes of the Academy of Sciences, but also on a close cooperation with the international advisory board of the EuroMISE Center, composed of leading professionals from European universities, research and health organizations.

EuroMISE course structure

As part of the EuroMISE project, three core groups of university teachers from participating organizations are harmonizing the development of the courses, the teaching materials and tools, and they propose lectures for courses given at the EuroMISE Center of Charles University and the Academy of Sciences in Prague. The core group for Medical Informatics (CG-MI) is under the responsibility of the Department of Medical Informatics of the Erasmus University of Rotterdam, The Netherlands. The fields of Medical Statistics (CG-MS) and Epidemiology (CG-ME) are respectively under the responsibility of the Department of Biometrics and Medical Informatics, Ruprecht-Karls University of Heidelberg, Germany, and the School of Public Health, Free University of Brussels, Belgium. Following the conclusions of the core groups on medical informatics, statistics and epidemiology, the structure of the EuroMISE courses was developed, and the first set of courses was given during 1994. The structure of the courses in 1994 consisted of 10 one-week intensive course modules on different subjects from medical informatics, statistics and epidemiology.

The first set of EuroMISE courses, in 1994, was addressed to Czech University teachers, physicians and health researchers. The lectures and practical

exercises were given during one week each month, in the period January - December 1994, with one month's break during the summer vacation. Practical exercises took place in the teaching laboratory of the EuroMISE Center, established with the financial support of the TEMPUS program, and equipped with 12 HP's 486 PCs, interconnected by Novell network.

The medical informatics part of the courses was prepared and presented by teachers from the Erasmus University Rotterdam and the University of Maastricht in The Netherlands, by teachers from the Ruprecht-Karls University of Heidelberg, the Phillips University of Marburg, and the MEDIS Institute of GSF, Neuherberg, in Germany, and finally by people from the University of Manchester, UMIST, in the UK. The topics covered by the intensive courses in medical informatics were the following:

- * *Introduction to medical informatics, ordering of medical informatics applications.* Information and communication in medicine; Coding and classification; Standardization in medical informatics; Databases and database management systems.
- * *Computer-based patient records; quality assessment and data protection.* Overview of developments in computer-based patient records; Communication in primary care; Technology and quality assessment; Data protection and security; Ethical and legal issues in medical informatics.
- * *Hospital information systems; bio-signals and images.* Overview of development in hospital information systems; Components of hospital information systems; Networking; Future of hospital information systems; Biosignal and image interpretation and processing.
- * *Decision support in medicine; knowledge acquisition and processing.* Statistical decision analysis; Knowledge based systems in medi-

cine; Neural networks; Evaluation of decision support systems.

The medical statistics and epidemiology part of the courses was prepared and presented by teachers from the Erasmus University Rotterdam, the Netherlands, Ruprecht-Karls University of Heidelberg, and the Phillips University of Marburg, Germany, the University of Dublin, Ireland, the University of Bordeaux II, France, the Aristotelian University of Thessaloniki, Greece and the Free University of Brussels, Belgium. In six one-week intensive courses the following topics were covered.

- * *Basics of medical statistics.* Basic statistical concepts; Principles of estimation and hypotheses testing; Overview of statistical tests: parametric vs. nonparametric, independent vs. dependent groups; Contingency tables, correlation, simple linear regression.
- * *Design and analysis of epidemiological studies.* Measures of disease frequency and of effect of risk factors; Confounding and effect modification, stratification; Design and analysis of cohort studies; Design and analysis of case-control studies.
- * *Clinical epidemiology.* Evaluation of diagnostic procedures; Design and analysis of prognostic studies; Design and analysis of clinical trials; Evaluation of quality measurement.
- * *Multivariate modeling of biomedical data.* Overview of multivariate methods; Multiple logistic regression; Model-building strategies; Application to clinical and epidemiological examples.

Each of these 11 one-week courses was divided into lectures and practical exercises. Czech participants gained hands on experience in the use of different software tools in the computer sessions. The evaluation of the first set of the EuroMISE courses by the Czech participants (according to the questionnaire elaborated in the core groups) was very positive. The importance of

computer sessions for physicians and health researchers was highly stressed.

Conclusions

It seems that the approach used for education and research in medical informatics, statistics and epidemiology matches the current educational and research needs in the Czech Republic as well as the needs in other central and eastern European countries. The approach might help to accelerate the development of education and research to reach the European level. It opens possibilities for long-term future cooperation among western and central/eastern European countries. University teachers and interested students trained in EuroMISE courses can further disseminate acquired knowledge and skills. The long-term effect of higher education will be an increase in the number of people with appropriate education for future healthcare. This will ensure that professionals involved in health care will be able to promote the results of medical informatics research into healthcare practice.

The goals agreed to by the EuroMISE Center open the possibilities to receive up-to-date education in medical informatics, statistics and epidemiology, not only for Czech university teachers, physicians and health researchers, but also for staff from cooperating central and eastern European institutions. The contacts established between countries of the European Union and central/eastern European countries might also contribute to European cooperation and result in interdisciplinary research for the future benefit of healthcare.

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Address of the author:

J. Zvárová,
European Center for Medical Informatics,
Statistics and Epidemiology,
Charles University,
Pod vodárenskou veží 2,
182 07 Prague,
The Czech Republic.